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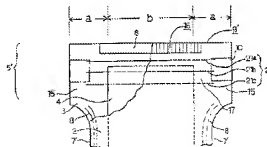
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(54) [Title]        DISPOSABLE DIAPER

(57) Abstract

[Purpose]        To provide a disposable diaper characterized by the fact that it can be put on easily and has sufficient stretchability while in use, with excellent fitting property and slip preventing property for the waist portion of the user.

[Constitution]    Disposable diaper (1) has liquid-permeable outer surface sheet (2), liquid-impermeable inner surface sheet (3), and absorbing member (4) included between said two sheets (2), (3); the disposable diaper also has waist gather (16) arranged on the peripheral edge portion of waist opening portion (6), and waist-wrapping gather (17) arranged parallel with said waist gather (16); elastic stretching member (21) forming said waist-wrapping gather (17) traverses at least a portion of the region where said absorbing member (4) is present; the stretchability of the region where said absorbing member (4) and said elastic stretching member (21) are arranged is lower than 25% before the diaper is put on, and the stretchability is at least 25% during use of the diaper; said absorbing member (4) has a modulus in the range of  $1.0 \times 10^3$  to  $2.5 \times 10^5$  g/cm<sup>2</sup> and flexural rigidity in the range of 20-200 g/cm.



### Claims

1. A disposable diaper characterized by the following facts: disposable diaper (1) of the spreadable type has liquid-permeable outer surface sheet (2), liquid-impermeable inner surface sheet (3) and absorbing member (4) included between said two sheets (2), (3); it also has waist gather (16) arranged on the peripheral edge portion of waist opening portion (6) and waist-wrapping gather (17) arranged parallel with waist gather (16);

said elastic stretching member (21) that forms said waist-wrapping gather (17) traverses at least a portion of the region where absorbing member (4) is arranged; the stretchability of the region where said absorbing member (4) and said elastic stretching member (21) are arranged is lower than 25% before the diaper is put on, and the stretchability is at least 25% during use of the diaper; said absorbing member (4) has a modulus in the range of  $1.0 \times 10^3$  to  $2.5 \times 10^5$  g/cm<sup>2</sup>, and flexural rigidity in the range of 20-200 g/cm.

2. The disposable diaper described in Claim 1, characterized by the fact that in waist-wrapping gather (17), the stretching property of the region where absorbing member (4) is arranged is different from that of the region where said absorbing member is not arranged.

3. The disposable diaper described in Claim 1 or 2, characterized by the fact that the product's stretchability of waist-wrapping gather (17) before the diaper is put on is in the range of 10-70%.

### Detailed explanation of the invention

[0001]

Industrial application field

The present invention pertains to a disposable diaper. More specifically, the present invention pertains to a spreadable type disposable diaper that can be put on easily and displays sufficient stretchability during use.

[0002]

Prior art and problems to be solved by the invention

The conventional spreadable type disposable diaper in the prior art has a liquid-permeable outer surface sheet, a liquid-impermeable inner surface sheet and an absorbing member included between said two sheets. An abdomen side waist wrapping portion positioned on the abdomen side of the user when the diaper is put on and the back side waist wrapping portion are joined to each other by a jointing means to form the waist opening portion and a pair of thigh opening portions. A waist gather is arranged on the peripheral edge portion of the waist

opening portion, and a waist wrapping gather is arranged as a member separated from the waist gather and near the waist gather.

[0003]

However, the disposable diaper in the prior art has the following problems. When the diaper is spread, the waist wrapping gather shrinks too much so that the absorbing member may be broken or damaged, and the overall spread diaper becomes shrunk, and this shape is undesirable when the user tries to put on the diaper.

[0004]

For example, Japanese Kokai Patent Application No. Sho 61[1986]-275402 proposed a disposable diaper having an elastic waist barrier in the abdomen side waist wrapping portion and the back side waist wrapping portion of the diaper. However, with this disposable diaper, because the waist barrier is a monolithic member that also has the function of a waist gather, the portions that should not shrink for a good fitting property shrink, so that it becomes extremely difficult to put on the diaper (the installing property is poor). This is undesirable.

[0005]

The purpose of the present invention is to solve the aforementioned problems of the prior art by providing a disposable diaper characterized by the fact that it can be put on for use easily, has sufficient stretchability during use, and has excellent fitting property and slip prevention property with respect to the waist of the user.

[0006]

Means to solve the problems

The present inventors have performed extensive research on this topic, and as a result of the aforementioned studies, it is found that when the diaper is spread, in order to ensure that the regions where the absorbing member and the waist wrapping gather are arranged are not broken or damaged, the modulus of the absorbing member and the stretching property of the elastic stretching member of the waist wrapping gather are major factors.

[0007]

The present invention was reached based on the aforementioned findings. That is, in order to realize the aforementioned purpose, the present invention provides a disposable diaper characterized by the following facts: the disposable diaper of the spreadable type has a liquid-permeable outer surface sheet, a liquid-impermeable inner surface sheet and an absorbing

member included between said two sheets; it also has a waist gather arranged on the peripheral edge portion of the waist opening portion and a waist-wrapping gather arranged parallel with the waist gather; said elastic stretching member that forms said waist-wrapping gather traverses at least a portion of the region where said absorbing member is arranged; the stretchability of the region where said absorbing member and said elastic stretching member are arranged is lower than 25% before the diaper is put on, and the stretchability is at least 25% during use of the diaper; said absorbing member has a modulus in the range of  $1.0 \times 10^3$  to  $2.5 \times 10^5$  g/cm<sup>2</sup> and flexural rigidity in the range of 20-200 g/cm.

[0008]

#### Operation

For the disposable diaper of the present invention, said elastic stretching member that forms said waist-wrapping gather traverses at least a portion of the region where said absorbing member is arranged. Consequently, by means of the absorbing member, it is possible to prevent excessive shrinkage of the elastic stretching member. As a result, when the diaper is spread, the diaper can hardly shrink, so that the user can easily put on the diaper. In addition, because the absorbing member has a high modulus before putting on, the absorbing member before use can maintain the original shape against the shrinking force of the elastic stretching member, so that the diaper can be put on even more easily. On the other hand, because the modulus during use is lower than that before putting on, deformation can take place corresponding to the torso shape of the user, that is, the fitting property on the torso of the user can be improved.

[0009]

#### Application examples

In the following, the present invention will be explained in more detail with reference to figures illustrating its application examples. However, the present invention is not limited to the application examples. Figure 1 is an oblique view illustrating Application Example 1 of the disposable diaper of the present invention. Figure 2 is an enlarged partially cut cross-sectional view illustrating the spread shape of the back side waist portion of the disposable diaper shown in Figure 1.

[0010]

As shown in Figures 1 and 2, disposable diaper (1) in this application example has liquid-permeable outer surface sheet (2), liquid-impermeable inner surface sheet (3) and absorbing member (4) included between said two sheets (2), (3). Here, back side waist wrapping portion (5) that is located on the abdomen side of the user when the diaper is put on and back

side waist wrapping portion (5') that is located on the back side of the user when the diaper is put on are joined with each other to form waist opening portion (6) and a pair of thigh opening portions (7). Here, waist gather (16) is arranged on the peripheral edge portion of waist opening portion (6), and waist-wrapping gather (17) is formed separated from waist gather (16) and parallel with said waist gather (16). Here, elastic stretching member (21) that forms waist-wrapping gather (17) crosses at least a portion of the region where absorbing member (4) is arranged.

[0011]

More specifically, as shown in Figures 1 and 2, absorbing member (4) in disposable diaper (1) of this application example is formed in a rectangular shape. Said outer surface sheet (2) and inner surface sheet (3) are formed in a curved shape similar to that of a hourglass, with the groin portion constricted. As shown in Figure 2, on thigh opening portion (7') and front/rear waist portions (9), (9'), elastic member (8) is arranged while stretched between outer surface sheet (2) and inner surface sheet (3). As a result, as shown in Figure 1, elastic member (8) shrinks in the free state, forming waist gather (16) and thigh gathers on the peripheral edge portions of waist opening portion (6) and thigh opening portions (7), respectively, so that the diaper can fit the waist and the groin portion of the user well. On the left/right flap portions (15), (15) of back side waist wrapping portion (5'), tape fastener (10) is arranged for joining said back side waist wrapping portion (5) and back side waist wrapping portion (5').

[0012]

As said outer surface sheet (2), a liquid-permeable sheet that allows permeation of the excrement to the absorbing member is used. Especially, it is preferred that the material have a good feel to the skin of the user. Examples of the liquid-permeable sheets that may be used include woven fabric, nonwoven fabric, and porous film, etc., of a thermoplastic resin. Due to seepage of urine from the peripheral edge portion of outer surface sheet (2), liquid leakage may take place. In order to prevent this problem, the peripheral edge portion of outer surface sheet (2) may be coated with a silicone oil base agent, paraffin wax or other hydrophobic compound, or the entirety of outer surface sheet (2) may be coated beforehand with an alkyl phosphate ester or other hydrophilic compound, followed by washing the peripheral edge portion of outer surface sheet (2) with warm water to make that portion water repellent.

[0013]

Said inner surface sheet (3) is prepared preferably as follows: a filler made of an inorganic compound or an organic compound is added in a thermoplastic resin, and the mixture is melt extruded using a T-die or circular die, followed by uniaxial or biaxial drawing to form a film sheet, which is preferably liquid-impermeable yet allows permeability of moisture. Especially, it is preferred that a material with good feel to the skin be used. A preferable example of the liquid-impermeable sheet is a composite material prepared from a thermoplastic resin film and a nonwoven fabric. In this application example, inner surface sheet (3) is made of a moisture-permeable polypropylene as the material that allows free sticking and removing of tape fastener (10) on/from it.

[0014]

Said absorbing member (4) may be made of a fluff pulp prepared by crushing wood pulp. It is preferred that a highly water-absorbing polymer be used together with said pulp. Especially, a mixture of a thermoplastic resin, the fluff pulp and a high water-absorptive polymer can be heat treated for use. Also, a mixture of the high water-absorptive polymer and the fluff pulp may be used, or it may be present only in a prescribed portion of absorbing member (4), such as the upper layer portion, middle layer portion, or lower layer portion. The high water-absorptive polymer can absorb and hold liquid of 20 times or more its own weight, and it preferably has a granular shape with gelling property. Examples of said high water-absorptive polymers that may be used include starch-base materials, cellulose-base and synthetic polymers, especially starch-acrylate (salt) graft copolymer, starch-acetonitrile copolymer's saponified compound, crosslinked product of sodium carboxymethylcellulose, and acrylic acid (salt) polymer, etc.

[0015]

As said elastic member (8), the conventional polyurethane and natural rubber type threads and ribbons may be used. Especially, the preferable types include yarn rubber, flat rubber, film type rubber, film-shaped foamed polyurethane, etc. It is preferred that for elastic member (8), the stress at 50% elongation be in the range of 40-100 g.

[0016]

There is no specific restriction on the type of the material for forming tape fastener (10). The types conventionally used in this field, such as tape material and adhesive, etc., may be used.

[0017]

In the following, the characteristic features of disposable diaper (1) in this application example will be explained. For disposable diaper (1) in the present application example, the stretchability of the region where absorbing member (4) and elastic stretching member (21) are arranged is as follows: the stretchability before use of the diaper is lower than 25%, or preferably in the range of 10-20%, before the diaper is put on, and the stretchability during use of the diaper is at least 25%, or preferably in the range of 25-80%. That is, there is no substantial stretchability before the diaper is put on, and the stretchability is then displayed while the diaper is put on. This is a characteristic feature. The stretchability can be determined using the following formula. Stretchability = width of the product of the absorbing member/width of the absorbing member under weight of 50 g x 100 - 100

[0018]

Said absorbing member (4) has a modulus before the diaper is put on in the range of  $1.0 \times 10^3$  to  $2.5 \times 10^5$  g/cm<sup>2</sup>, or preferably in the range of  $7.0 \times 10^3$  to  $1.8 \times 10^4$  g/cm<sup>2</sup>, and a modulus during use of 50% or lower than that before the diaper is put on. For absorbing member (4) with said property, before the diaper is put on, absorbing member (4) does not shrink and it maintains the original shape against the shrinking force of waist-wrapping gather (17) or waist gather (16). Consequently, the diaper can be easily put on the user. On the other hand, during use, absorbing member (4) itself has stretchability, so that it can deform corresponding to the torso of the user. If the modulus of absorbing member (4) before the diaper is put on is below said range, shrinking takes place even before the diaper is put on, so that the diaper can hardly be put on. On the other hand, if the modulus is over said range, no shrinkage takes place even after the diaper is put on. Here, "before the diaper is put on" in the present invention means the state in which there is no deformation before the diaper is put on the user. "During use" means that the diaper shrinks after putting on the user.

[0019]

The flexural rigidity of absorbing member (4) before putting on is preferably in the range of 20-200 g/cm, or more preferably in the range of 50-100 g/cm. If the flexural rigidity is lower than said range, there is little stiffness, and the absorbing member is too weak. On the other hand, when the aforementioned range is overrun, the stiffness is too high to make any deformation. The flexural rigidity is a parameter related to the stiffness of absorbing member (4). The higher the flexural rigidity, the higher the stiffness, and the lower the flexural rigidity, the lower the stiffness.



[0020]

According to the present invention, the modulus and flexural rigidity of absorbing member (4) are determined using the following formulas according to the method shown in Figure 3. In this method, absorbing member (4) is arranged between two supporting points, and a weight is applied on about the central portion of absorbing member (4). The deflection of absorbing member (4) caused by the weight is measured. The deflection and the following formula are used to compute the modulus and flexural rigidity of absorbing member (4).

Modulus = [distance between supporting point<sup>3</sup>/(4 x width x thickness<sup>3</sup>)] x weight applied/deflection

Flexural rigidity = weight applied/deflection

[0021]

According to the present invention, when absorbing member (4) is manufactured, a high water-absorptive polymer and other additives as needed are mixed in the fluff pulp prepared by crushing wood pulp, and the mixture is formed to the shape of the absorbing member, and it is wrapped with a tissue paper sheet. The unit is then fed through a pair of embossing rolls to obtain an absorbing member (4) with rigidity. The rigidity of absorbing member (4) depends on the pressure applied on the embossing rolls, so that the pressure of the embossing rolls should be adjusted to within the aforementioned range. Also, as needed, a hot melt or other adhesive may be applied in a spiral shape to further increase the rigidity.

[0022]

As shown in Figures 1 and 2, waist-wrapping gather (17) is formed parallel with waist gather (16) formed on the peripheral edge portion of the waist opening portion. Said elastic stretching member (21) that forms waist-wrapping gather (17) crosses at least a portion of the region where absorbing member (4) is arranged. The stretching property of elastic stretching member (21) is closely related to the modulus of absorbing member (4). It is preferred that the stress of elastic stretching member (21) when elongation is 100% be in the range of 50-500 gf, or more preferably in the range of 100-300 gf. If the stress at elongation of 100% is lower than said range, there is no change after installation, and the function is insufficient, and the diaper tends to fall off. On the other hand, if the stress is over said range, the stretching force is too high so that the skin may be harmed. As shown in Figure 2, elastic stretching member (21) partially crosses absorbing member (4) in the longitudinal direction of the diaper. However, the present invention is not limited to the aforementioned embodiment. As another embodiment, for example, the entirety of elastic stretching member (21) crosses the absorbing member (see Figure 5 to be explained later).

[0023]

There is no specific restriction on the length of elastic stretching member (21) in the waist direction of the diaper. It is preferred that said elastic stretching member (21) be longer than the width of absorbing member (4), and the end portion of elastic stretching member (21) go over absorbing member (4) and reach flap portion (15). In this case, it is preferred that among waist-wrapping gather (17), the stretching property in the region where said absorbing member (4) is arranged be different from that of the region where said absorbing member is absent. That is, as shown in Figure 2, among waist-wrapping gather (17), the stretching property of the portion present on absorbing member (4) and on the extension in the longitudinal direction of absorbing member (4) (the region indicated by (b) in Figure 2) is preferably different from that of the portion present on flap portion (15) (the region indicated by (a) in Figure 2). Here, the stretching property means a property of the product. In this way, it is possible to improve the fitting property for preventing fall-off of the diaper. In this way, as shown in Figure 2, there is no specific restriction on the method for having the stretching property of region (a) different from that of region (b). For example, when elastic stretching member (21) is applied while stretched on the portion of waist-wrapping gather (17), the scheme for applying the tension of elastic stretching member (21) for region (a) is different from that for region (b), or the stretching property of elastic stretching member (21) itself in region (a) is different from that in region (b).

[0024]

There is no specific restriction on the length of elastic stretching member (21) in the longitudinal direction of the diaper. It is preferably in the range of 5-30 mm, or more preferably in the range of 10-25 mm. There is no specific restriction on the material and shape of elastic stretching member (21). The same material as that for making said waist gather (16) and the thigh gathers, such as yarn rubber, flat rubber, film type rubber, or film-like foam polyurethane, etc., may be used. For example, if the yarn rubber is used, as shown in Figure 2, three elastic stretching members (21a), (21b), (21c) are arranged, and among said elastic stretching members (21), second elastic stretching member (21b) and third elastic stretching member (21c) are arranged on absorbing member (4).

[0025]

According to the present invention, there is no specific restriction on the relative positions of elastic stretching member (21) and tape fastener (10). It is preferred that elastic stretching member (21) be arranged so that at least a portion of it is present on the extension of tape fastener (10) in the waist direction. With said configuration, the elastic stretching member

and the tape fastener are interlocked, so that fall-off of the diaper can be prevented even more reliably.

[0026]

Before the diaper is put on, the product stretchability of waist-wrapping gather (17) should be in the range of 10-70%, or preferably in the range of 15-45%. If the product stretchability is lower than the aforementioned range, the effect in preventing fall-off becomes less significant, and the waist-wrapping gather cannot work well. On the other hand, if the product stretchability is over the aforementioned range, the stretching force becomes too strong, and the feel to the skin deteriorates. According to the present invention, the product stretchability (%) is defined by the following formula: product stretchability (%) = width of the product of diaper/width of the diaper under load of 50 g x 100 - 100

Here, the width of the diaper under load of 50 g refers to the width of the diaper when a load of 50 g is applied in the waist wrapping direction for the portion of waist-wrapping gather (17).

[0027]

As explained above, the stretchability of waist-wrapping gather (17) is closely related to the modulus of absorbing member (4). For waist-wrapping gather (17), at the natural length of the diaper, tape fastener (10) is equipped, and the shrinking force when the diaper is stretched by 30 mm in the waist wrapping direction is preferably in the range of 50-500 gf, or more preferably in the range of 100-300 gf. If the shrinking force is lower than said range, there is no effect in preventing fall-off. On the other hand, if the shrinking force is higher than said range, a force is applied on the bonding with the tape, and the diaper fits poorly.

[0028]

According to the present invention, waist-wrapping gather (17) may be arranged on either back side waist wrapping portion (5) or back side waist wrapping portion (5'), or as needed, it may be arranged on both back side waist wrapping portion (5) and back side waist wrapping portion (5').

[0029]

The disposable diaper of the present invention may have the structure shown in Figures 4-7. Here, Figures 4-7 are enlarged partially cut cross-sectional views (corresponding to Figure 2) illustrating the waist portion of the diapers in Application Examples 2-5. Except the

following explained features, that explained above for said Application Example 1 may be adopted appropriately in these application examples.

[0030]

For the disposable diaper in Application Example 2 shown in Figure 4, waist barrier (20) extending towards absorbing member (4) from the end edge portion of waist opening portion (6) is laid between absorbing member (4) and surface sheet (2), and elastic stretching member (21) is laid on waist barrier (20) to form waist-wrapping gather (17). There is no specific restriction to the method for laying elastic stretching member (21). For example, waist barrier (20) on absorbing member (4) is folded back to the side of outer surface sheet (2) to have a double structure, and elastic stretching member (21) is arranged in the waist direction so that it is held between the double structure portions. In this case, elastic stretching member (21) that forms waist-wrapping gather (17) may at least cross the region where absorbing member (4) is arranged.

[0031]

In this way, by forming waist-wrapping gather (17) on waist barrier (20), when the user lies down, it is possible to prevent liquid leakage from the joint portion between outer surface sheet (2) and inner surface sheet (3) at the waist portion of the user, and at the same time, it is possible to improve the fitting feel and the liquid leakage prevention property at the waist portion of the user.

[0032]

As the material for forming waist barrier (20), polyolefin compound doped with an inorganic material may be used. The thickness should be in the range of 20-150  $\mu\text{m}$ , or preferably in the range of 30-50  $\mu\text{m}$ . When the thickness is smaller than the aforementioned range, the strength of waist barrier (20) is low, and the operability in manufacturing the diaper is poor. On the other hand, when it is over the aforementioned range, the diaper becomes too soft to have a good feeling to the user.

[0033]

Figure 5 is a diagram illustrating the disposable diaper in Application Example 3. In this application example, both the two elastic stretching members (21) are arranged on absorbing member (4), and elastic stretching member (21) is bonded and secured only on the portion excluding the portion present on absorbing member (4) (the hatched portion shown in Figure 5).

[0034]

For the disposable diaper in Application Example 4 shown in Figure 6, three elastic stretching members (21) are bonded and secured only in the left/right two corner portions (and their nearby regions) of absorbing member (4) (the hatched portions in Figure 6).

[0035]

In the disposable diaper in Application Example 5 shown in Figure 7, three elastic stretching members (21) are bonded and secured only on absorbing member (4) and its nearby region (the hatched portion shown in Figure 7).

[0036]

The present invention is not limited to the aforementioned application examples. For example, waist-wrapping gather (17) may be arranged in the same structure as that of back side waist wrapping portion (5), and it is possible to perform appropriate adjustment for the number and material of elastic stretching members (21).

[0037]

Effect of the invention

The disposable diaper of the present invention has excellent fitting property and fall-off preventing property. Also, the diaper can be put on easily, and at the same time, it has excellent leak preventing property at the joint portion between the outer surface sheet and the inner surface sheet at the waist portion of the user.

#### Brief description of the figures

Figure 1 is an oblique view illustrating Application Example 1 of the disposable diaper of the present invention.

Figure 2 is a partially cut cross-sectional view illustrating the spread state of the back side waist-wrapping portion of the disposable diaper shown in Figure 1.

Figure 3 is a diagram illustrating the method for measuring the modulus and the flexural rigidity of the absorbing member.

Figure 4 is a partially cut cross-sectional view (corresponding to Figure 2) illustrating the spread state of the back side waist wrapping portion in Application Example 2 of the disposable diaper of the present invention.

Figure 5 is a partially cut cross-sectional view (corresponding to Figure 2) illustrating the spread state of the back side waist wrapping portion in Application Example 3 of the disposable diaper of the present invention.

Figure 6 is a partially cut cross-sectional view (corresponding to Figure 2) illustrating the spread state of the back side waist wrapping portion in Application Example 4 of the disposable diaper of the present invention.

Figure 7 is a partially cut cross-sectional view (corresponding to Figure 2) illustrating the spread state of the back side waist wrapping portion in Application Example 5 of the disposable diaper of the present invention.

#### Explanation of symbols

- 1 Disposable diaper
- 2 Outer surface sheet
- 3 Inner surface sheet
- 4 Absorbing member
- 5 Back side waist wrapping portion
- 5' Back side waist wrapping portion
- 6 Waist opening portion
- 7 Thigh opening portion
- 7' Thigh portion
- 8 Elastic member
- 10 Tape fastener
- 15 Flap portion
- 16 Waist gather
- 17 Waist-wrapping gather
- 20 Waist barrier
- 21 Elastic stretching member

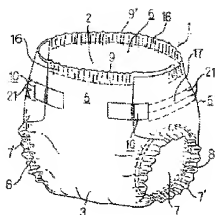


Figure 1

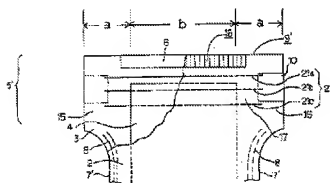


Figure 2

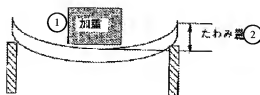


Figure 3

Key: 1 Load





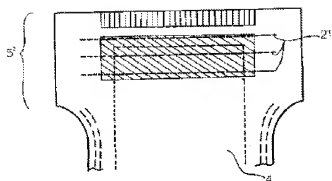


Figure 7